DOCUMENT RESUME

ED 282 748 SE 048 172

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TITLE Improving Achievement and Attitudes in Elementary Algebra through Written Error-Correcting Feedback and Free Comments on Tests.
PUB DATE Jun 87
NOTE 69p.; Master of Education Thesis, National College of Education.
PUB TYPE Reports - Research/Technical (143) -- Dissertations/Theses - Master Theses (042)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Algebra; Criterion Referenced Tests; *Feedback; Mathematics Achievement; Mathematics Education; *Mathematics Instruction; Mathematics Teachers; *Mathematics Tests; Reinforcement; Secondary Education; *Secondary School Mathematics; Student Attitudes; Student Evaluation; *Teacher Response

ABSTRACT

The purpose of this study was to investigate the extent to which written error-correcting feedback on teacher-made criterion-referenced tests results in increased achievement of high school students taking algebra. In addition, student attitudes toward chapter tests and changes that may occur in those attitudes resulting from teacher treatment of tests was considered. Two classes of algebra students were used, one being the control group and the other, the experimental group. Students in the control group received their usual treatment of tests at the end of each chapter, and test papers were returned with incorrect responses marked wrong and a test grade. The incorrect responses were discussed both in and out of class with the teacher. All students in the experimental group received the same treatment as the control group. In addition, they were provided with written, error-correcting feedback on their examination papers. This feedback included "free comments" (e.g. words of encouragement and compliments for creative solutions). The findings showed no significant connection between the feedback provided and increased achievement. Possible reasons for this result included the inability to control extraneous variables, and the lack of validity and reliability of the tests used. A 41-item reference list and a student survey instrument are included. (TW)

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IMPROVING ACHIEVEMENT AND ATTITUDES IN ELEMENTARY ALGEBRA THROUGH WRITTEN ERROR-CORRECTING FEEDBACK AND FREE COMMENTS ON TESTS

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By

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a field research report

submitted in partial fulfillment

of the requirements for the degree of

Master of Education, Field-Based Generalist Concentration

The Foster G. McGraw Graduate School of

NATIONAL COLLEGE OF EDUCATION

June, 1987

SE 048 172

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CHAPTER ONE: PLAN OF THE STUDY

Focus

The purpose of this study was to discover the extent to which written error-correcting feedback on teacher-made criterion-referenced tests results in increased achievement of high school students taking elementary algebra. In addition, student attitudes toward chapter tests and changes that may occur in those attitudes resulting from teacher treatment of tests is studied.

Rationale

Tests can be valid and valuable teaching tools that some teachers invest time in constructing and administering. Almost all teachers use test grades in their assessment of student learning and performance and in their evaluation of instruction techniques and effectiveness (Levin, 1981). Because teachers put so much time, effort, and emphasis on testing, teachers should optimize the uses of tests. Providing the most effective feedback to students is one way to make tests worthwhile learning and evaluative instruments.

One important factor in the quality of instruction is a feedback-corrective procedure (Bloom, 1976).

Writing comments on students' test papers has been shown to have a real and beneficial effect on their mastery of subject matter. This effect was found for all secondary levels and for both "better" and "poorer" students (Page, 1958).

Medical students who were provided with both oral and written post-examination feedback on correct and incorrect responses reported studying all of the feedback. In addition to, and perhaps as important as improving their test results when retested on the same items, the students held positive attitudes toward tests and teacher feedback (Markus, Mast, & Soler, 1980).

The research department of Racine Unified School District reports an increase in the failure rate of ninth- grade algebra students in the past three years. At the same time, public opinion calls for better student performance in mathematics. The primary reason for studying the effects of test feedback is to improve achievement (as measured by tests) and to promote a more positive attitude toward testing and learning.

Research Design and Methods

Two classes of elementary algebra students participated in this study. One class group was designated the experimental group and the other, the control group.

All students in the control class received the usual treatment of chapter tests. Test papers were returned with incorrect responses marked wrong and a test grade. Each student had the opportunity to discuss responses both in and out of class. Students were encouraged to correct their mistakes and request extra instructional help when necessary. The teacher presented to the entire class the most common errors and necessary corrections. Review exercises were available. Students had the opportunity to take a second test after review was completed. To facilitate this mastery learning technique, many different forms of each test were prepared. A check list for the teacher and for each class were used to record completion of each of the above steps. The teacher made field notes of observations, conversations, extra help sessions, and review work requested and completed by students.

All students in the class containing the experimental group received all of the treatment previously described. In addition, however, they were provided with written, error-correcting feedback on their examination papers. This feedback included free comments (e.g., words of encouragement and compliments for creative solutions) and other appropriate suggestions.

The experiment was conducted throughout the first semester of the 1986-1987 school year, during which time, tests were given on six chapters. Data were collected for students from both algebra classes and includes scores on all tests taken as well as observation and checklist records of review work and/or extra help sessions in which students were involved. At the end of the semester, a final examination was given. The first part of the research question is answered by comparing the semester test and chapter test results for the control group students with those of the experimental group students.

To assess student attitudes toward algebra chapter tests, students in both algebra classes were surveyed at the beginning and end of the semester using a

researcher-prepared questionnaire that included scaled items and open-ended questions. The researcher was particularly interested in learning how anxious students feel about tests, how they perceive the feedback provided, and the type and amount of preparation for the test they engage in.

The researcher interviewed two algebra teachers from each of Racine's three public high schools to discover the types of feedback and test treatment these teachers provide for their students. The interviewees were asked to assess their efforts regarding test treatment as a way to improve achievement. Data from these interviews supplements and/or supports what the researcher learned of test treatment and feedback from the review of the literature.

CHAPTER TWO: REVIEW OF THE LITERATURE

Introduction

The purpose of this study was to examine the effects of teacher treatment of tests on student achievement in algebra. To understand the importance of the feedback students may be given on tests and the role feedback has in instruction, the research on feedback and teacher comments is examined. But first, it is necessary to look at the place feedback has in a theory of learning and to explore the concept of feedback.

Theory of Learning

The feedback/correctives component of instruction is an important one. And while this will be supported by research studies discussed later, it is first necessary to provide a brief discussion of a prominent learning theory so that the purpose and role of feedback is understood.

A theory of school learning proposed by Bloom (1976) deals with three central variables: student characteristics, instruction, and learning outcomes. Each student comes to the classroom with two types of characteristics: cognitive entry behaviors--the prerequisite subject content and cognitive skills needed

for particular learning tasks, and affective entry characteristics--the interests, attitudes, and motivation to learn new learning tasks. The learner's history determines what those behaviors and characteristics will be and how they will affect learning. Although the history of the learner is a principal element of school learning, Bloom believes that those student characteristics can be modified.

Along with student characteristics, it is the quality of instruction that determines the learning outcomes. These outcomes are the level and type of achievement, the rate of learning, and the affective characteristics of the learner, as related to the learning tasks and self.

The most important learning variable, according to Bloom, and one that is highly alterable, may be the quality of instruction. The components of the quality of instruction include cues, participation, reinforcement, and a system of feedback and correctives. By modifying the components, it may be possible to achieve the optimal learning outcomes.

Varying characteristics in students produce variation in the accomplishment of learning tasks both

in level of achievement and learning rate. To lessen this variation, feedback and correctives are necessary. However, the same correctives may not be effective for all individual students.

A feedback and correctives system is imperative because of the group nature of most school instruction. Feedback and correctives for each student, an integral part of the teaching-learning process, should be adequate and appropriate.

Although the orientation is quite different from the Bloom theory, the feedback theory purported by Solomon and Rosenberg (1964) also highlights the importance of feedback as it relates to the group setting of the classroom. They believe feedback has powerful implications for the classroom social structure. Feedback has not only a reinforcement function, but, because of the added information provided by correctives, also a directing function. Teachers' use of feedback and students' perceptions of feedback may influence the group social structure.

In summary, learning theory states what research will show; that is, that although there are many factors affecting learning, feedback and correctives are an

important component of instruction and will affect student learning. Effects of feedback and correctives may also be found in student attitude and in the group social structure that develops in the classroom.

The Concept of Feedback

It has been stated that feedback means more than reinforcement and that, when used with correctives, it has additional functions. Before the research on feedback is discussed, some theorists' views of the concept of feedback are presented.

In the context of student learning, the term feedback has been used for knowledge of results. Bruner (1968) suggests that student learning is affected by knowledge of results only where and when the knowledge can be used for correction. There are other elements besides knowledge of results in an effective feedback process. Nishikawa's (1985) review of current literature on feedback draws the conclusion that feedback is a process more complex than a stimulus-response pattern and proposes that feedback "be viewed as knowledge of response affected by variables within the individual and environment" (p. 18).

Levin (1981) describes the feedback-correction process as an interrelated cycle of three components: the definition of a preset standard of performance, feedback information regarding what has been learned and what remains to be learned, and corrective procedures prescribed so that mistakes or misunderstandings can be corrected. Feedback and corrective procedures need to be provided at regular intervals to prevent accumulation of errors and misunderstandings. If not, students are unlikely to adequately learn or master a particular learning task.

To continue Levin's theory, as students consistently receive feedback and correctives, they gradually require fewer correctives to reach the predetermined standard. Achievement improves as well as learning habits, self-confidence, and interest in the subject content.

It is evident, then, that the feedback-correctives process involves providing a learner with knowledge of results and a prescription for correction. The interaction of both components will affect the learning process. At this point, it is appropriate to examine specific research studies regarding feedback.

Feedback Research

In most of the research on feedback covering many content areas, post-test results are compared for subjects that received feedback with control group subjects that did not receive feedback. Recent studies have controlled for additional variables. For example, the effects of delayed or immediate feedback are compared as are the feedback effects on retention and transfer of information. The effects of feedback on student attitudes as well as research studies in the content area of mathematics and their implications for teachers are of special interest to the present study.

Early Studies

Plowman and Stroud (1942) found that when students were informed of the correctness of their responses to test questions, they performed better on a second test one week later. Karabinus's (1966) study concluded that students who receive knowledge of correct responses on test items in class learn more of the examination content than students who did not receive such knowledge in class. This was true for both short-range and long-range retention.

Effects of Feedback

In his reveiw of work done on feedback, especially as it applies to written instruction, Kulhavy (1977) concludes that feedback increases student learning. Correct responses are confirmed for learners and errors are identified and corrected. The greatest positive effect is when feedback follows incorrect responses. If feedback is provided often during a learning task, students have the increased opportunity to learn.

In a study of different forms of feedback provided students and the effects on retention and transfer (Sassenrath & Garverick, 1965), all three groups of students that received feedback show treatment effects when compared to a group that received no feedback. On a retention examination, students benefited more from a discussion of test items by the instructor than from rereading the textual material. Results for the group that had questions discussed were also significantly better on the transfer examination.

Not all feedback studies focus on cognitive learning. Mevarech (1983) concluded that a feedback-correctives procedure is beneficial in training psychomotor application skills. Students exposed to

individualized mastery instruction with feedback correctives performed better on mechanical tasks than students exposed to individualized conventional instruction without corrective activities. This effect was found for subjects of both higher and lower academic achievement ability.

These studies point to the positive effects on learning that result when feedback and correctives are provided for students. Many researchers have further questioned the timing of feedback: Should test feedback be immediate or delayed?

Immediate or Delayed Feedback

Peeck and Tillema (1979) identify the "delay retention effect" and posit that delayed feedback yields greater retention than immediate feedback. The delay retention effect is supported by Sassenrath (1975) in his analysis of data from several experiments on immediate and delayed feedback. Learners are more likely to correct their initial wrong responses if feedback is delayed. The explanation offered is that, during the delay interval, subjects tend to forget their wrong responses and are informed, through feedback, of the correct responses to substitute. Feedback,

immediate or delayed, however, had little effect on correct responses. This finding strengthens the definition of feedback as an element more than merely reinforcement of a response. Where student learning is concerned, feedback is a more powerful tool for cognition than an incentive for motivation.

In a study by Sturges (1972a) the focus was on the retention effects of instruction regarding feedback provided and instructional cues presented. The findings suggest that the use of informative feedback and the immediate practice following feedback are the important factors affecting retention. The results of another study (Sturges, 1972b) further support the researcher's position that the delay retention effect is explained, not because of what happens during the delay interval, but rather because of factors functioning at or following feedback. Retention is improved if students acquire information relevant to the retention of an item. This can be facilitated by delaying feedback or by manipulating the form of the feedback, for example, with a cue.

The interaction of time of feedback and students' perception of ability was investigated in a study by

Joseph and Maguire (1982). Fourth-grade students received knowledge of their results on a multiple-choice achievement test measuring arithmetic skills immediately after the test or one day following the test. Significant gains were found over the interval between the first, second, and third tests for both immediate and delayed feedback groups when compared to a control group that received knowledge of results only following the third test. Delayed feedback was found to be most beneficial for students with low perceptions of their abilities.

In a study by Beck and Lindsey (1979), the effects of immediate and delayed information feedback following a pre-test were examined. The importance of feedback is supported by results that showed significant gains on a post-test by all students that received feedback. Since no significant differences were found when feedback was immediate or delayed, the researchers conclude that the timing of feedback is not an important factor, at least not for university graduate students.

The review of these studies seems to indicate agreement regarding the positive effects of feedback. However, if and why delayed feedback is more beneficial

to retention has not been conclusively shown. Because of the nature of the classroom situation faced by this researcher, test feedback will most certainly be delayed. Therefore, further concern for the unanswered question of immediate or delayed feedback is unnecessary under these circumstances. Of greater interest is the effect of feedback and correctives on student achievement and attitudes.

Effects on Attitude

Medical students' use of feedback and their attitudes toward the feedback were investigated in a study by Markus, Mast, and Soler (1980). Two types of feedback, written and oral, were provided after examinations. The purpose of the study was to determine (1) if elaborate instructional feedback would aid learning and (2) how students used the feedback. Researchers concluded that students did learn from the feedback: test scores significantly improved. The mode of delivery of the feedback, however, was not a factor. Students reported studying all the feedback. Results from an attitude survey reported a favorable attitude toward the feedback as an instructional tool.

One of the variables in a study by Wentling (1973) was specificity of test item feedback. Three levels of feedback were used: no specific item feedback (no knowledge of results), partial item feedback (knowledge of correctness of response), and total item feedback (knowledge of correct response). Students receiving the partial feedback treatment produced both the highest mean achievement score and the highest mean attitude score.

A Competency/Evaluation Profile was the maximum feedback used in a study by Beach (1979). A computer printout provided students with a profile that graphically showed the student's strengths and weaknesses on electronics tests. Classes that received the maximum feedback information had a higher mean achievement score on the final competency examination than classes receiving minimum feedback of results. These maximum feedback classes also showed a more favorable attitude toward the assessment procedure by scoring higher on attitude scales.

The importance of student attitudes and the effects of attitude on achievement is a commonly held belief. These studies indicate that the use of feedback and

correctives result in more favorable attitudes in students toward tests and test feedback. Of course, as achievement improves, more positive attitudes would be expected.

Feedback to Math Students

In the collective literature on feedback, many content areas are represented. Because the present study involves algebra students and because the content area of mathematics may be differential in regard to a feedback-correctives procedure, it is most appropriate to examine research on feedback to math students.

To determine the effects of feedback-corrective procedures and problem solving strategies on mathematics achievement, Mevarech (1980) conducted a study with 208 high school students. Students were assigned to four learning opportunities: a specific algorithmic strategy without feedback-correctives (minimal learning opportunity), a general-heuristic strategy without feedback-correctives, a specific algorithmic strategy with feedback-correctives, and a general-heuristic strategy with feedback-correctives (maximal learning opportunity). Only when both problem solving and feedback-corrective strategies were emphasized did most

students master both higher and lower cognitive processes. Furthermore, the effects of the algorithmic and heuristic strategies over a series of learning tasks were increased by the feedback-correctives.

In another study, Levin (1975) provided feedback and corrective procedures to ninth-grade algebra students learning probability rules. These students were better able to perform on application problems requiring probability rules than students who were not provided with feedback and corrective procedures.

Sixth-grade math students were the subjects of one study (Hannafin, 1980) on systematized feedback. Delayed feedback was provided on bi-weekly mini-quizzes for a 12 week period. When a post-test was given, a feedback class scored significantly higher than both an internal control class and an external control class taught by a different teacher. This study is noteworthy because the system of feedback involved both teacher and student, was integrated within the instructional context, and was provided in the natural classroom setting. Furthermore, while most delayed feedback studies have involved the use of multiple-choice tests,

this study documents the effectiveness and practicality of feedback used in a process-oriented content area such as mathematics computation.

These studies indicate the value of using feedback and correctives in the content area of mathematics. A teacher that employs a feedback and correctives procedure that is an integral part of instruction in the mathematics classroom can expect gains in achievement, especially where problem solving and application skills are concerned.

Implications for Teachers

In view of the importance of feedback and correctives within a theory of learning and the conclusions drawn from research studies on feedback and correctives, it is fitting to examine the implications this practice holds for classroom teachers. The use of criterion-referenced tests and teachers' practice of providing feedback are examined below.

Mevarech and Amiran (1982) investigated the role of criterion-referenced tests and the feedback they provide students. Some 845 high school math students who were given criterion-referenced tests and who received feedback on their performance throughout a semester

scored higher on the end-of-semester test than students who were assigned the same instructional program but were not exposed to the criterion-referenced testing. The researchers attribute the results to two factors -- the characteristics of the tests and the feedback procedure.

Bloom and Bourdon (1980) studied the use of written feedback by 183 elementary school teachers. Volunteer subjects were asked to grade a math paper as they would typically grade a paper for one of their own students. Researchers classified the results into seven feedback strategies. Most teachers in the study graded merely for "rightness" or "wrongness" of response and provided no corrective feedback. In fact, noncorrective feedback was used almost three times as frequently as corrective feedback. The authors conclude that teachers' practice regarding the use of feedback and correctives does not reflect what feedback research and prominent learning theory suggests is most effective in student learning.

The research literature provides several cases in which feedback and correctives aid learning and retention. While there may not be complete agreement on the best type of feedback and the most beneficial timing

of its use, researchers generally agree on the positive effects feedback has on student achievement and attitudes. These conclusions are found for studies in many content areas, including the area of mathematics.

Teacher Comments

In a handbook for teachers regarding the use of tests (Fielding & Schalock, 1985), the value and use of test feedback is stated:

> Feedback from tests that draws attention to specific learning goals or objectives that students have attained, that points out learning expectations that have yet to be reached, or that indicates what steps need to be taken to achieve learning outcomes desired, is more valuable as an aid to learning than information that is highly general, for example, an overall test score. (p. 11)

The authors further propose that feedback be personalized and that teacher comments emphasize feedback and suggest steps for improvement. In this section, studies about teacher comments are examined, various replication studies or similar studies are

compared, and finally, the relationship of letter grades and teacher comments is discussed.

Page's Study of Teacher Comments

Page (1958) investigated the effects of teacher comments on student performance and compared the results of specified comments with free comments. In 74 classrooms in many subject matter areas, 2,139 secondary students were divided into groups designated "no comment," "free comment," or "specified comment." Test papers were graded and returned to no comment students with numerical score and grade only. Free comment students received whatever comment the teacher felt appropriate in addition to score and grade. The specified comments were designated in advance for each letter grade. For example, all "A" papers in the specified comment group received the same comment: "Excellent! Keep it up." On the test following the treatment, the results were studied by ranking the test scores. The highest scores were achieved by students in the free comment group. The specified comment group scored higher than the no comment group. The treatment effect in 12 different schools and in six different

grade levels (grades 7 - 12) was not significantly different.

The power of this study may be in the many studies conducted to attempt replication of Page's work. In some later research, the effects of related variables were examined.

Research Related to Page's Study

Although Page's study, which ran for two weeks, did not investigate the long-term effects of teacher comments, Stewart (1975) applied teacher comment treatment to groups of students for six weeks. No significant immediate or long-term effects of the treatment were found. In a study by Sweet (1966), neither free nor specified comments had a significant short-term effect on test performance. Free comments were found to influence test scores when used over a longer period of time. In this study, only free comments significantly changed student attitudes in a positive way.

Austin (1976) conducted a study similar to the study by Page except that Austin studied the effects of teacher comments written on homework papers. For six weeks, teachers of nine math classes provided either

free or no comments on homework papers they graded. Results show no difference between the comment group and the no comment group on examination scores in seven of nine classes. Homework comments did not affect achievement in any of the four algebra classes participating in the study.

In a study of written teacher comments on spelling papers of fourth and sixth grade students, Lesner (1967) found that students who received comments on their papers improved performance on subsequent tests. Greater treatment effect was found for students from low socioeconomic areas than for students from high socioeconomic areas. Students in low spelling groups had a more favorable response to teacher comments than students in top spelling groups.

Research in various subjects and grade levels has examined the effects that written teacher comments on test and homework papers have on future learning and attitude changes. In several studies (Allen, 1972; Hake, 1973; Klinger, 1971; Mapel, 1970; Moody, 1970; Shrago, 1970; Starkey, 1971), researchers found that written teacher comments had little or no effect on student achievement or attitudes when measured before

and after such treatment. Rhoads (1968) suggests that, for slow learners, there may be a connection between written comments and later performance. Simons (1971) concludes that written comments from teachers may be potentially helpful or harmful depending on the personality of the student receiving such comments. Test anxious students are unlikely to show improvement in achievement as a result of a written teacher comment. Other variables related to the effects of teacher comments are the achievement level of the student, the student's perception of his or her ability, and the student's perception of the teacher's feeling toward him or her.

Efforts of these many researchers to replicate the Page study have generally failed to show, conclusively, the same effects of teacher comments on student achievement. There is some evidence that comments may positively effect lower ability students.

Comments and Grades

Stewart and White (1976) explored the question of whether a comment alone had the same effect as a comment accompanying a letter grade. The immediate treatment effects showed that it is the comment given in

conjunction with a letter grade that may improve performance. However, there was little or no evidence for similar long-term effects of this treatment.

Research by Hammer (1972) examined the effects of teacher comments on the test performance of 87 college physics students. Students were assigned to three treatment groups: a no comment group that received letter grades only, a group that received a letter grade and a predetermined specified comment, and a specified comment/grade expectation group. Students in the third group were asked what grade they expected following the test. They received the letter grade determined appropriate by the instructor and a specified comment appropriate to the combination of the grade expected and the grade received. Results of a second examination showed the specified comment group and the specified comment/grade expectation group performed better than the no comment group. Specified comment/grade expectation students performed better than those receiving specified comments. Hammer concludes that comments are effective for improving achievement and, apparently, if the comments incorporate students' grade expectations, the technique becomes more valuable.

Teacher written comments used in an individualized and personalized approach are suggested as a way to positively affect student performance.

Conclusion

This literature review shows the importance of a feedback and correctives procedure in instruction. Knowledge of results and a prescription for correction is necessary for student learning. Clearly, feedback affects achievement and possibly affects attitude, regardless of whether it is immediate or delayed. Research evidence that written teacher comments result in greater improvement is less conclusive. The present study will further explore the value of a teacher providing students with error-correcting feedback and encouraging comments on test papers.

CHAPTER III: OUTCOMES OF THE TREATMENT

Introduction

This study examines the effects of test treatment on student achievement in elementary algebra and student attitudes toward tests. As I have marked and graded algebra tests over the years, noting the kinds of mistakes made by students and feeling the urge to show corrections and to write comments that might be appropriate for teaching or encouraging the student, I have often wondered if those marks helped students learn from tests or improved their attitudes toward tests. The purpose of this study of test treatment was to discover the effects of written error-correcting feedback and written teacher comments on student test papers. My hypothesis was that written corrections and comments provided by the teacher on test papers would increase student learning and improve the attitudes students have toward tests. It follows, then, that, as students increase their learning and as their attitudes improve (making them less anxious about tests and eager to learn from their mistakes), their achievement, say on a final semester test, would be greater because of the written feedback they receive on chapter tests.

Procedures

Participants

The student participants in this study were two class groups of high school algebra students. The school is a large, urban, traditional four-year high school. Both classes contain a mixture of males and females and are racially integrated. The elementary algebra course has traditionally been a course for ninth-graders and is the first course in the algebra - geomery - intermediate algebra/trigonometry sequence. However, recent reorganization of the school district into four-year high schools and an increase in the number of mathematics credits required for graduation has precipitated a change in the student population of algebra classes. [Previous to 1983, ninth-graders were in junior high school. Beginning with the class of 1989, students are required to successfully complete two units (years) rather than one unit of mathematics for graduation.] Algebra classes are no longer primarily ninth-grade classes. The two classes involved in this study were no exception: Of the 60 students represented, approximately 58% were 9th-graders, 33% were 10th-graders, and 8%, 11th-graders.

As the make-up of algebra classes has changed, so has the mathematics history or preparation of the student. The ninth-grade students were recommended for algebra by the eighth-grade math teacher. All had passing grades in "8 Math" with 83% B's and C's. The 10th- and 11th-graders took "9 Math" (general math), "Essentials for Algebra" (pre-algebra), or failed to pass algebra last year. A teacher recommendation was suggested, but not required, for algebra this year. The previously mentioned changes have effected all algebra classes in the school. The two groups studied were representative of all algebra classes in the school.

In designing this study, five months before implementation, I wanted to study only ninth-graders. However, because of the nature of current algebra classes with regard to grade level and preparation, it seemed inappropriate to ignore 42% of the population, students who are not ninth-graders. There is no reason to expect the demographics of algebra classes to change in the near future. Furthermore, any study appropriate for algebra students should involve <u>all</u> algebra students, regardless of year in school or mathematics history. Students beyond the ninth-grade will be in

those algebra classes; their learning needs and concerns need to be included. Therefore, data were collected for all students in these two algebra classes.

One of the two classes is designated the experimental group and the other, the control group. These designations were assigned at random. The experimemtal class of 27 students met fourth period, 10:01 - 10:48 A. M., daily. The control class of 33 students met eighth period, 1:29 - 2:16 P. M., daily. Although the classes met in two different classrooms, both classrooms adequately meet the requirements regarding space, light, and furniture. The same textbook and supplementary materials were used for both classes and the same teacher taught both classes. The study was conducted during the first semester of the 1986 - 1987 academic year.

Tests

Six chapter tests were given during the semester. The tests occurred approximately every 13 to 15 school days, depending on the length of the chapter and the school calendar. The teacher-prepared, criterion-referenced tests parallel department tests given by other algebra teachers at this school. Each test was

preceded by a day of review and all tests were announced at least two days in advance. All students took the same test in the regular class period setting. Make-up tests for students that were absent on the test day were sometimes given another parallel form of the test. Students who decided to retake the test approximately a week after the initial test also took a parallel form of the test.

Test items were identical to the types of questions presented in class lectures, homework assignments, and quizzes. Most of the test items were short-answer items which called for simplifying number and variable expressions, evaluating variable expressions or formulas, naming properties used, solving equations and inequalities, translating word phrases and sentences into algebraic phrases and sentences, performing operations on polynominals, and common monomial factoring. Some test items included word problems and number-line graphs of number sets and solutions to inequalities . No differences in the learning activities or experiences of each class were intended. The lesson plans, objectives, classroom activities, and homework and quiz experiences were intentionally the

same for both the experimental and control classes. The same objectives were held for both classes; it was those objectives that were tested through the use of chapter tests.

At the end of the semester, both groups were given a semester final test covering the first semester objectives. This fifty-item, multiple-choice test is administered to all elementary algebra students in the school district. Students were allowed 75 minutes to complete the test.

Test Treatment

After the chapter tests were marked and graded, the tests were returned to the students in each class. I made every effort to keep the "turn around" time to a minimum and succeeded in returning the test papers in one, two, or three school days. (The average was two days.) Each test paper contained a grade based on the percent correct. Test items that had incorrect responses were marked wrong. Many items were graded for partial credit. For example, a one-operation equation such as $3x = -9$ with a correct solution worth four points that contained a sign mistake showed -2 points rather than -4. A word problem whose correct solution

required a "let" statement identifying what the variable stands for, an appropriate equation, the steps taken to solve the equation, and a sentence giving the solution, was marked according to the number of correct components. Some test items that required two answers (for example, "Simplify. Then evaluate for m = 3: -(3m+5) + 2m") were marked for the two parts of the correct answer.

Before I returned the test papers to the students, I recorded the percent grades in my gradebook. In addition, I did an item analysis to identify test items that were most frequently missed and those items that were mastered by most students. I prepared review examples and located "extra practice" materials for those objectives of the test that were not mastered by many students. To examine each set of class test data, I prepared a frequency distribution, noted the range, and computed the mean and median for each chapter test.

When the test papers were handed back to the students, I told them what common mistakes they made, worked some representative problems, and commented generally on the performance of the class. I encouraged them to study their mistakes and rework some of the

problems, invited questions, and let them keep the test papers. If any student wanted extra practice, appropriate materials were identified - primarily from the textbook and supplementary worksheets. At this time a "retest" was announced and students had an opportunity to sign up for that test as a way to improve their test scores. I encouraged them to get additional instructional help from me and/or review after school or during a study hall. This treatment was provided for both experimental and control classes.

The delayed feedback provided to both groups included both knowledge of results and some prescription and opportunity for correction or improvement. Besides receiving the oral and written feedback previously described, the experimental group received additional written feedback. All errors and omissions on their test papers were corrected in writing. For some test items this meant simply noting a missing negative sign or an incorrect exponent. For some items I completely rewrote, for the student, all the steps to correctly show a solution to, for example, an equation or story problem. In many cases instructional comments or reminders such as sign rules, exponent rules, or

order-of-operations procedures were written. Comments such as "Watch the signs!", "The order property is the Commutative property," "Write a 'let' statement," "Show your check," "To multiply powers of x, add the exponents. For example, $(x2)(x3) = x5$," "The 'nickname' for x^2 is 'x squared'," and "Use the distributive property to remove parenthese first." were freely offered. Occasionally my suggestions were a departure from or an alternative to the way I usually taught a procedure. For example, before the correction for an error, I wrote "Your steps to solving this type of equation aren't working. Try setting it up this way -- you might understand this 'vertical' arrangement better." I also circled trouble spots and drew loops and arrows to direct the student's attention to what should have been done.

Another type of comment was part of the experimental test treatment. I am referring to "free" comments, rather than "specified comments" that were, hopefully, appropriate for the student's situation and the student's work. Perfect or near-perfect papers rated an "EXCELLENT!!" or "GREAT!" It was easy to write "Good," "Keep up the good work," or "Nice job!" on A

and B papers. For students that failed the test, I often wrote comments such as "Why not work on this and retake the test?," "See me for help," or "Let's review this and you can try again on the second test. I'm sure you can do better!" It was sometimes appropriate to remind students to "Work harder on your homework so you have had more practice on this." If a student who usually did fairly well on tests really had a low grade, I wrote "What happened? I know you know more than this! Want to try the test again?" On a few occasions I had to think hard to come up with what I thought might be an appropriate comment: "I truly appreciate all your efforts. Some of this takes time to understand. Hang in there!!" As comments were written, I tried to use the student's name to make the comments more personal.

Data were collected throughout the semester. Scores for all the chapter tests and the semester final test were recorded for each student present for the test. Make-up test scores were recorded as well as scores on second tests that some students elected to take. Student requests for review work and extra-help sessions with students were recorded as field notes. I

made notes of the types of test-item corrections and comments I made in my treatment of tests as well as the oral feedback given in class when the tests were returned.

Student Attitudes

Part of the hypothesis of this study concerns attitudes students have toward tests. To determine if the written feedback and comments students receive on test papers effect a change in their attitudes toward testing and learning from tests, these attitudes should be measured before and after the treatment is received. To draw comparisons between the two treatment groups, it was necessary to measure the attitudes of both groups of students. In order to accomplish this, I prepared and administered a survey questionnaire (See Appendix). The first survey was given during the second week of school, nine days before the first chapter test. The same survey was completed again one week before the semester final test.

The survey contained 16 Likert scale statements concerning student attitudes in three areas: the value and importance of tests; the feedback students receive from tests; and test anxiety. Students were instructed

to choose one of the following responses to each statement: strongly agree; agree; no opinion; disagree; and strongly disagree. Students were also asked to write comments regarding tests, how tests are marked, and the information they receive on tests.

In administering the survey, I took great care that the instructions were understood. I also pointed out that I wanted their answers about "tests" defined as chapter tests, given in class and graded by the teacher, not standardized tests such as the CTBS or other tests the school district administers to all students of a grade level from time to time.

Teacher Interviews

Since the literature review offered little information from teacher-practitioners regarding the way teachers currently treat criterion-referenced chapter tests, I hoped to receive that kind of information from some of my local colleagues. I interviewed six high school algebra teachers, two from each of the local public high schools. The six interviewees, chosen at random from lists of each school's teachers of elementary algebra, included two men and four women having a mean of 19 years of teaching experience. Five

of these six teachers have taught algebra at both the junior high and high school levels.

After a brief description of this study, I asked each interviewee how he/she treats chapter tests for algebra students. My primary interest was in the type and amount of test feedback they provide students. I also asked about their policies and practices regarding make-up tests, retests, test preparation, and retention of the test papers by the student. Finally, I asked each to assess their efforts with regard to treatment of tests.

Findings/Interpretation

The mean scores for all six chapter tests and the final test for the experimental group are greater than the mean scores for the control group (See Figure I). However, the differences in the means are slight with the exception of the Chapter 4 test. Computation of the standard error of the difference between the two means shows that the actual difference is less than the expected difference based on chance alone except in the Chapter 2 and Chapter 4 cases (See Table 1). Using a t-ratio, none of the differences are statistically significant at the $p < .01$ level. Only the t-test for

FIGURE 1: COMPARISON OF GROUP MEAN SCORES

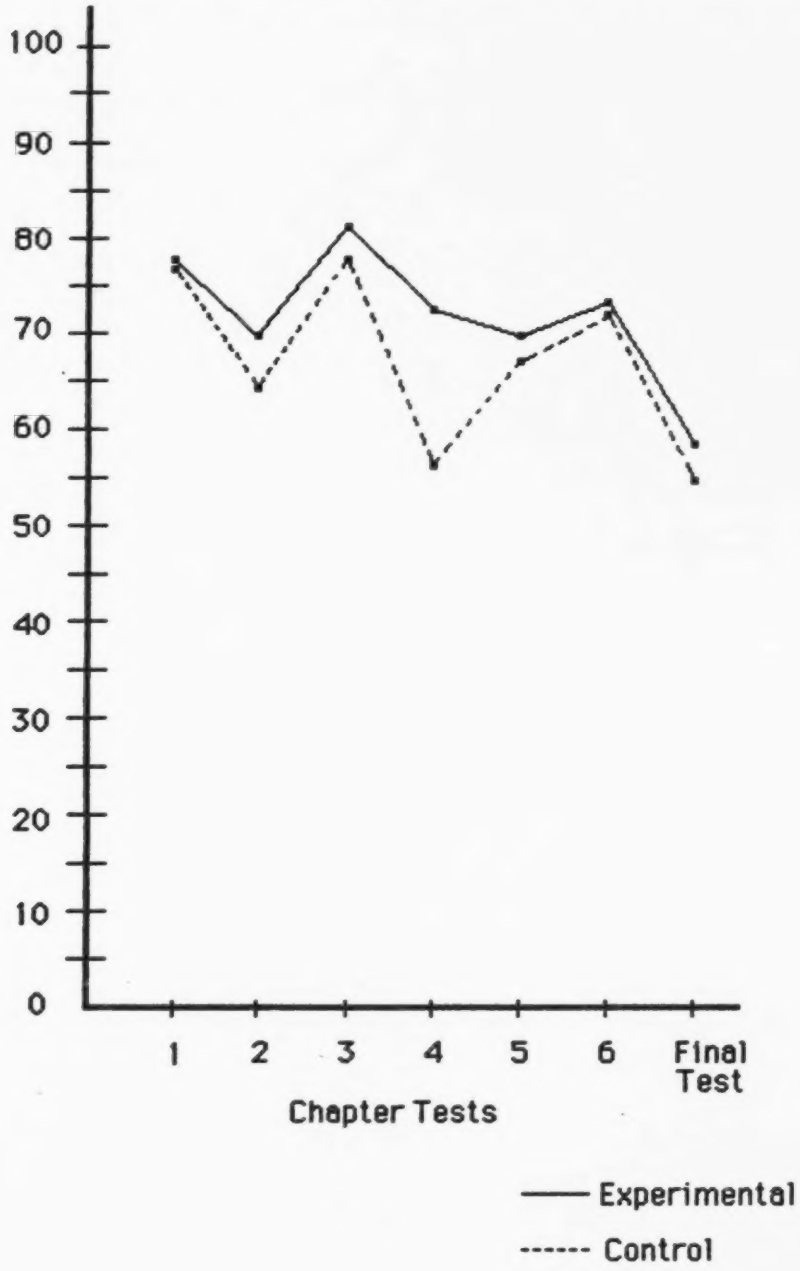


Table 1: GROUP MEANS, DIFFERENCES, t-RATIOS

Test	x_1	x_2	$x_1 - x_2$	s	t
1	77.7	77.2	0.5	3.35	0.15
2	70.0	64.6	5.4	4.50	1.20
3	81.9	78.3	3.6	3.97	0.91
4	72.5	57.4	15.1	6.37	*2.37
5	70.4	68.1	2.3	4.02	0.57
6	74.5	73.4	1.1	4.64	0.23
Final	58.7	55.6	3.1	3.79	0.82

* statistically significant at the .05 level, $p < .05$

x_1 = Experimental Mean

x_2 = Control Mean

$x_1 - x_2$ = Actual Difference

s = Expected difference

t = t-ratio

the Chapter 4 test shows a statistical significance at the $p < .05$ level. It is necessary, therefore, to retain the null hypothesis concerning the treatment effects on achievement.

Students in both classes had the option of retaking a test to improve the score. In calculating means and students' grades, I used the greater of the two test scores in all those cases in which a student took a second test. It was my hope and expectation, that, after students reviewed and corrected their previous mistakes, they would perform better on the second test. I also expected all students with low scores to take advantage of this opportunity. Students soon discovered that, other than possible personal embarrassment, there was little risk since I agreed to count the better score in assigning grades.

What actually happened did not live up to my expectations. Thirty-seven students (16 from the experimental group and 21 from the control group) participated in 81 retests. There was little difference in the results from both classes. In 57% of the second attempts, scores improved. Five percent remained the same and 38% of the second test grades were lower. Not

all students with D or F test scores elected to try to improve their grades. It should be explained that although I encouraged, and sometimes strongly suggested this action for some students, taking a retest was ultimately the student's choice. Furthermore, students were required to sign up a week in advance and take the test during a study hall or after school. It was difficult (but not impossible, I'm sure) for those students who rode a school bus home after school and/or did not have a study hall time available to make arrangements to take these tests. At the end of the semester when students completed the attitude survey, several commented that they appreciated the second test opportunity and thought it was a good policy.

I have explained that, for both algebra classes, when feedback was provided orally and in written form, all students were given suggestions for review work and invited to request extra help. Some students who were motivated to do so used extra class time to talk to me about their test errors. Others made appointments to get help after school or during a study hall if I was available at that time. Four students from the experimental class and five from the control class were

involved in such sessions. Seven other students had a study hall in the cafeteria during the same class period that I supervised in that area. They received their extra help at that time. These sessions after school or during study hall were used to go over material the student did not understand. On some occasions we discussed review work the student had completed. Sometimes we worked on test corrections. At other times it was necessary to go over work a student had missed because of an absence from school.

The effects of extra help sessions and review work are difficult to determine. Only about one-half of the students involved chose this avenue more than once. I had four "regular customers" and for three of them it was convenient to come to my study hall. Nevertheless, test performance for these students was not always satisfactory after help sessions.

Marking and grading test papers takes time. Since I did all of the marking and recordkeeping, and since writing complete error-corrections and comments on some of the tests would require extra time, I kept a record of the amount of time I spent on each set of chapter tests. The time needed for marking tests for the

written feedback group was, on average, about two times that required for the control class. Each chapter test for the experimental class required an average of two hours of time spent marking the papers, writing comments, computing mean and median, preparing an item analysis, recording results, and planning examples and review work. This finding is important, in my opinion, and has implications for practitioners. As teachers weigh the outcomes of the treatment suggested in this study, effective use of their time should be considered.

To discover any changes in student attitudes toward tests and test treatment, data from the attitude survey were examined. Since all students in both groups received some of the same treatment, it is appropriate to first look at the differences in all students' attitudes before and after treatment. The frequencies of responses have been combined into two categories; "Agree" and "Disagree". Percent of total responses in these two categories have been computed for each of the 16 survey items. For the purpose of comparing the amount of agreement with positive attitude statements, it was necessary to restate six of the items. (For example, 74% of those surveyed <u>disagreed</u> with the

statement "Tests are a waste of time." This was interpreted to mean that the same percent of those surveyed agreed that "Tests are not a waste of time.") As I have stated previously, I separated the attitude statements into three areas: value and importance of tests, feedback on tests, and anxiety.

Measured differences in student attitudes on the value and importance of tests are shown in Figure 2. Gains were made in students' feelings that tests are important for learning, are not a waste of time, and that tests are valuable to the teacher. Although no change is noted in the value of tests for students, two-thirds of the students do agree that tests are valuable. The only negative change in this area is in what learning tests truly measure.

Figure 3 shows the changes in student attitude toward test feedback. For all but one item, no difference or only slight differences are observed. It is noteworthy that, after the treatment, 83% of all students feel they can learn from their tests compared with 71% agreement before the treatment. However, no greater percent of those students attribute that learning to efforts of the teacher.

FIGURE 2: STUDENT ATTITUDES TOWARD THE VALUE AND IMPORTANCE OF TESTS

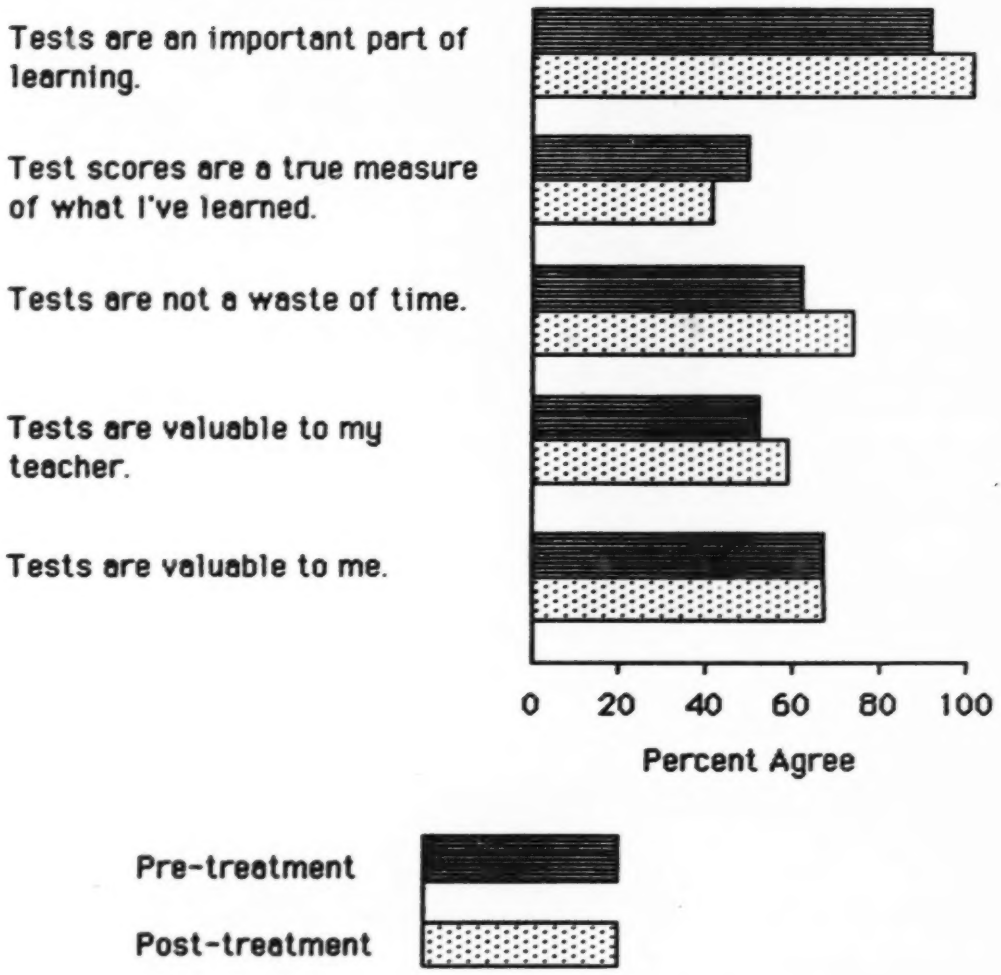
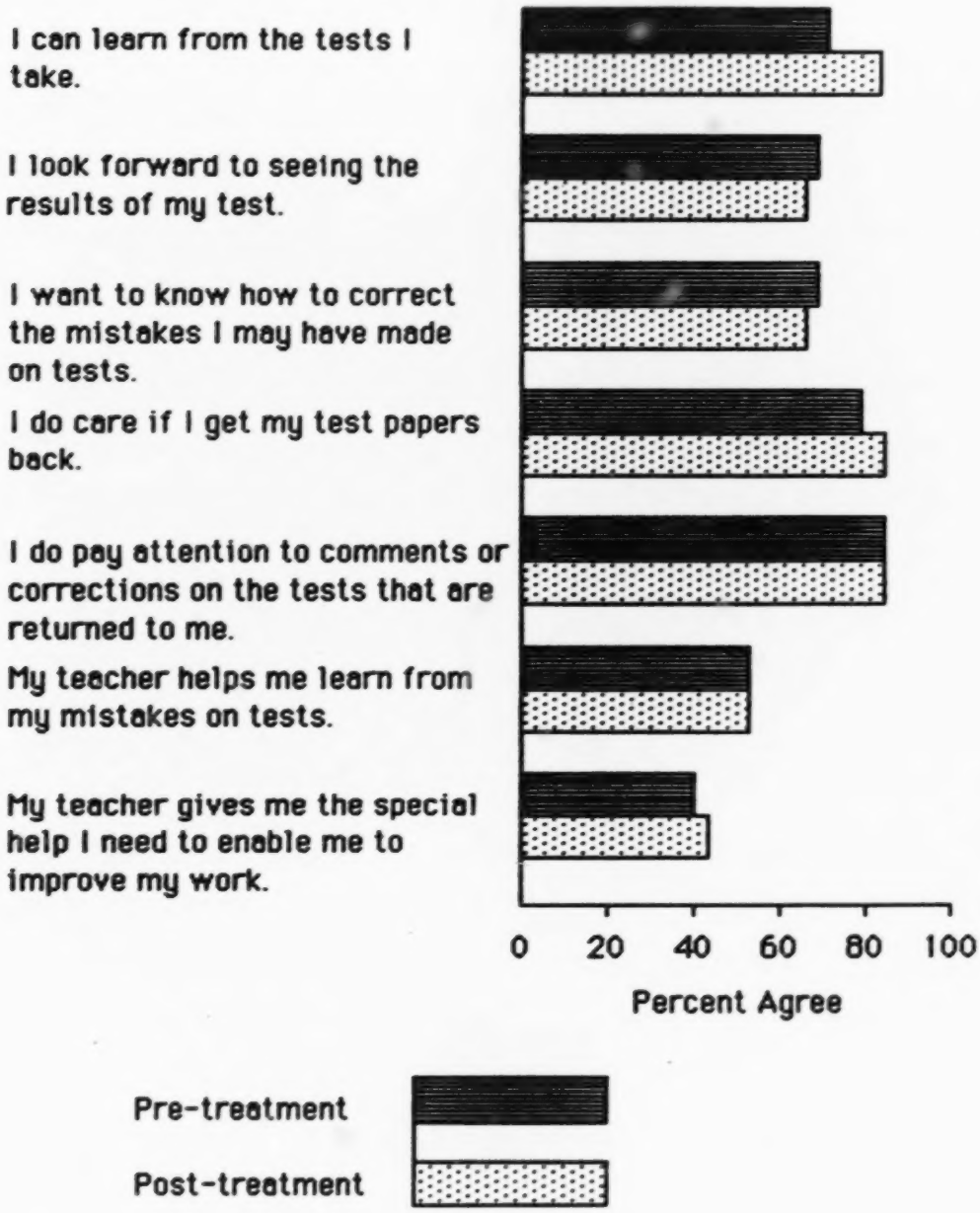


FIGURE 3: STUDENT ATTITUDES TOWARD TEST FEEDBACK


I can learn from the tests I take.
I look forward to seeing the results of my test.
I want to know how to correct the mistakes I may have made on tests.
I do care if I get my test papers back.
I do pay attention to comments or corrections on the tests that are returned to me.
My teacher helps me learn from my mistakes on tests.
My teacher gives me the special help I need to enable me to improve my work.
0
20
40
60
80
100
Percent Agree
Pre-treatment
Post-treatment

Attitudes about test anxiety are shown in Figure 4. Even though some gain is observed, only approximately one-third agree that they are not nervous about tests. Many fewer students feel that studying for tests helps and fewer also agree that they know how to study for tests. Fewer students report showing test papers to parents. This finding is not surprising since 58% of the students involved in this study were first-year high school students who probably do much less of that than they did in elementary and middle school. It is not clear to me if this practice is a cause or effect or simply not related to test anxiety.

Table 2 shows gains and losses for each treatment class in percent of agreement with the survey statements. The control class shows gains in some areas and losses in others. Most noteworthy are the many gains in positive attitudes for the class that received written feedback and comments on tests. Gains for all survey items pertaining to feedback are observed for this group. The most striking differences are that, for the students who received written comments and corrections on their papers, greater numbers agree that tests are an important part of learning and that they

FIGURE 4: STUDENT ATTITUDES TOWARD TEST ANXIETY

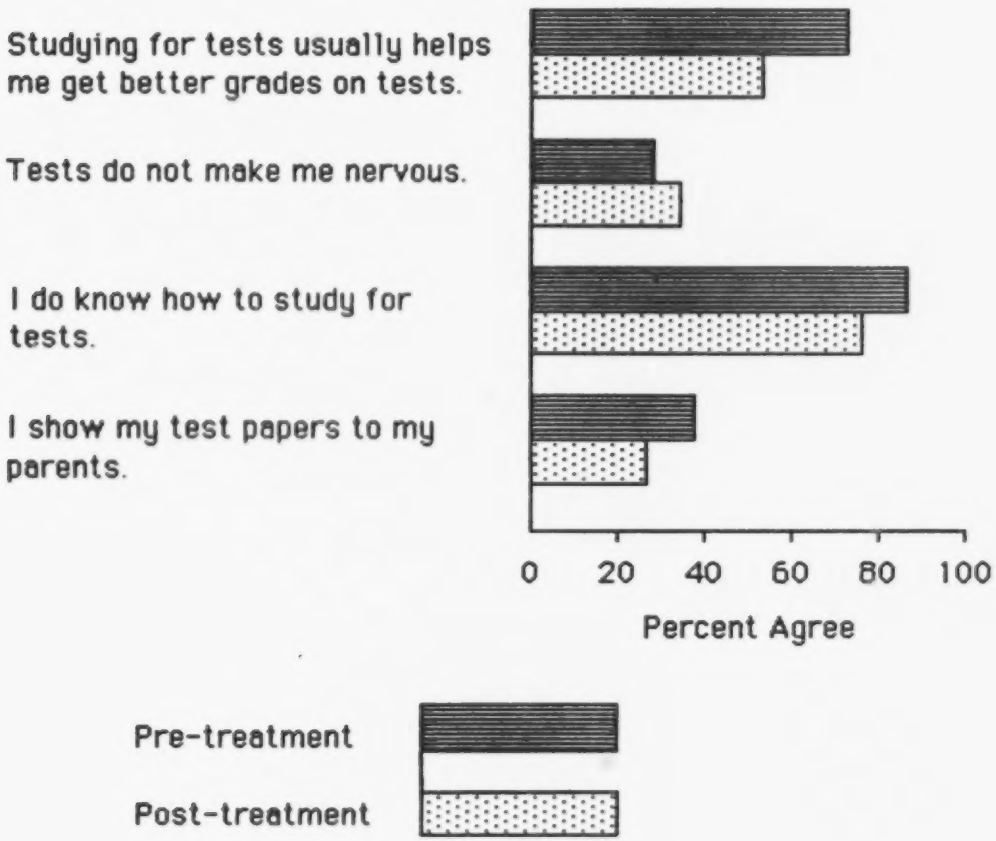


Table 2: GAINS/LOSSES FROM PRE-TREATMENT TO POST-TREATMENT

SURVEY ITEM	EXPERIMENTAL GROUP	CONTROL GROUP
VALUE AND IMPORTANCE OF TESTS:		
Tests are an important part of learning.	+19	-7
Test scores are a true measure of what I've learned.	-7	-9
Tests are not a waste of time.	+4	+19
Tests are valuable to my teacher.	+4	+9
Tests are valuable to me.	+4	-4
FEEDBACK:		
I can learn from the tests I take.	+23	+3
I look forward to seeing the results of my test.	+4	-10
I want to know how to correct the mistakes I may have made on tests.	+12	-16
I do care if I get my test papers back.	+11	0
I do pay attention to comments or corrections on the tests that are returned to me.	+4	-3
My teacher helps me learn from my mistakes on tests.	+11	-9
My teacher gives me the special help I need to enable me to improve my work.	+12	-4

Table 2, Continued

ANXIETY:

Studying for tests usually helps me get better grades on tests.	-12	-25
Tests do not make me nervous.	0	+13
I do know how to study for tests.	+4	-22
I show my test papers to my parents.	-23	-3

can learn from the tests they take. Additional evidence for this effect of the test treatment is found in some of the comments students volunteered on their post-treatment surveys. Many students wrote that the corrections and comments they received helped them learn from their mistakes.

Interviews with six algebra teachers provide some comparisons of common test treatment practices with those examinied in this study. I discovered that these teachers share several common policies or procedures for algebra testing. All provide oral feedback to students upon returning the tests, usually by discussing most frequently missed items and answering questions in class. One-half additionally provide some written feedback, pointing out errors in student work or writing corrections. All provide some informational and/or motivational comments to some students. For two teachers, this practice is used regularly and for two others, only rarely. All six teachers are currently sharing the tests they use with other teachers at the school. Each teacher interviewed uses the same tests, with revisions, for several years. Five of the six cited security as the reason they do not allow students

to keep test papers. The one dissenter, regarding this policy, did not share the concern for test security. All of those interviewed said they tried to return the tests as soon as possible, usually within one or two days. Two mentioned they want feedback to the students not to be delayed very long. Several teachers share my concern of what to do about make-up tests for absent students but had no new ideas or suggestions for a solution to this problem. When I asked about giving a second test, two teachers responded "No" in such a way that it was obvious they would not consider that option. One teacher replied, "That would not be to anyone's advantage." Of the other four teachers, two said they do that only in special cases, and two teachers have tried that and found it to be much less than a satisfying experience. One said "Oh, I've tried that, too. It's not worth it!" The response of the other was "I've given second tests, but not often. The results are usually worse than the first time."

After I questioned these teachers about their specific practices, I asked them to assess the manner in which they treat tests and if doing something more would be worth their additional time and effort. Three of

them seemed satisfied with their practices. One man said he did his best and it could only be better if he could work with students individually. Another said he always reviewed before a test and never had any "surprises" for his students on tests. One teacher said she felt it was a good idea to test often, maybe twice during a long chapter, especially when working with ninth-graders. The almost apologetic, but honest, response from another was:

> My primary use of tests is purely for grading. If I didn't have to grade the student, I probably wouldn't even stop and give the test. It's not that valuable a tool for me, as a learning device, but I need something on the record to grade the students. Maybe I treat tests less 'usefully' than others -- or than I should -- but many times I think their day-to-day experiences are better than the test experiences are. Time is a problem . . . there's not time to go back and review or reteach . . . and our numbers are too big.

The frustration another teacher felt was apparent as she told me of her current concern: "I'm looking for new ideas myself . . . trying to figure out a new approach." She said she has tried some of the treatment examined in this study and found that "no matter how much more I put into it, it doesn't get better."

Conclusions

Testing my students has fulfilled several purposes for me. Besides providing me with evidence I needed for grading, information about the effectiveness of my own teaching, and data for the evaluation of curriculum materials, I have long felt that tests could be a tool for learning if students were given feedback regarding their performance. This study was personally significant because it enabled me to answer some questions about the actual effects of that feedback on students' learning.

The findings fail to show a strong connection between the feedback I provided and the increased achievement I hoped to see. Possible reasons for this may include other variables between the two classes that were impossible to control (e.g., student attendance patterns, learner history, time of day for each class,

outside-of-school influences, and individual student behavior and motivation). Furthermore, the tests used, both chapter tests and the final semester examination, have not been scrutinized for validity and reliability. In any case, the error of retaining a false null hypothesis has no serious consequence. Teachers (myself included) will most likely continue to provide test feedback for their algebra students in some form and in some degree. Hopefully such feedback may lead to some long-term effects on students' attitudes as they discover that they can learn more if they pay attention to the information they receive on their tests.

Some of the findings from this study do provide further evidence to support conclusions drawn from the literature review; in particular, that feedback is an important component of instruction, that some feedback correctives may not be effective for all individual students, and that corrective feedback and "free" comments may result in more favorable attitudes. To be effective in the classroom, educators will find it necessary to provide the kinds of information and encouragement that individual students need. Decisions that teachers make regarding the manner in which they

engage in providing feedback and the most effective use of their time must be made carefully. As a teacher looks for ways to improve achievement and attitudes of algebra students, testing practices and the day-to-day learning experiences provided should be examined.

REFERENCES

Allen, M. L. (1972). An investigation of the relationship between written teacher comments on classroom tests and achievement in and attitudes toward college mathematics (Doctoral dissertation, University of Virginia, 1972). Dissertation Abstracts International, 33, 1013A.

Austin, J. D. (1976). Do comments on mathematics homework affect student achievement? School Science and Mathematics, 76(2), 159-164.

Beach, D. P. (1979). Effects of evaluation feedback on student achievement. Journal of Vocational Education Research, 4(3), 1-13.

Beck, F. W., & Lindsey, J. D. (1979). Effects of immediate information feedback and delayed-information-feedback on delayed retention. Journal of Educational Research, 72, 283-284.

Bloom, B. S. (1976). Human characteristics and school learning. New York: McGraw-Hill.

Bloom, R. B., & Bourdon, L. (1980). Types and frequencies of teachers' written instructional feedback. Journal of Educational Research, 74(1), 13-15.

Bruner, J. S. (1968). Toward a theory of instruction. New York: W. W. Norton.

Fielding, G. D., & Schalock, H. D. (1985). Integrating teaching and testing: A handbook for high school teachers. Monmouth, OR: Oregon State System of Higher Education, Teaching Research Division. (ERIC Document Reproduction Service No. ED 257 821)

Hake, C. (1973). The effects of specified written comments on achievement in and attitude toward algebra and geometry (Doctoral dissertation, Pennsylvania State University, 1973). Dissertation Abstracts International, 34, 1700A.

Hammer, B. (1972). Grade expectations, differential teacher comments, and student performance. Journal of Educational Psychology, 63, 454-458.

Hannafin, M. J. (1980). Systematized feedback and mathematics performance. Paper presented at the annual convention of the Association for Educational Communications and Technology, Denver, CO. (ERIC Document Reproduction Service No. ED 194 069)

Joseph, C. H., & Maguire, T. O. (1982). The interaction between time for feedback and academic self-concept on level of performance in arithmetic skill. Journal of Educational Research, 75(6), 360-365.

Karabinus, R. A. (1966). Differential examination feedback treatments, learning, and attitudes (Doctoral dissertation, University of Illinois, 1966).

Klinger, R. L. (1971). The effects of written positive statements on academic performance of fifth grade students (Doctoral dissertation, University of Texas, Austin, 1971). Dissertation Abstracts International, 32, 6206A.

Kulhavy, R. W. (1977). Feedback in written instruction. Review of Educational Research, 47, 211-232.

Lesner, J. (1967). The effects of pupil-corrected tests and written teacher comments on learning to spell in the upper elementary grades (Doctoral dissertation, University of California, Los Angeles, 1967). Dissertation Abstracts International, 28, 542A.

Levin, T. (1975). The effect of content prerequisite and process-oriented experiences on application ability in the learning of probability (Doctoral dissertation, University of Chicago, 1975). Dissertation Abstracts International, 35, 4432A.

Levin, T., & Long, R. (1981). Effective instruction. Alexandria, VA: Association for Supervision and Curriculum Development.

Mapel, S. B., Jr. (1970). The influence of the instructor's written comments upon student test performance in the college classroom (Doctoral dissertation, North Texas State University, 1970). Dissertation Abstracts International, 32, 247A.

Markus, J. F., Mast, T. A., & Soler, N. G. (1980). The effects of written and oral feedback following examinations. Journal of Medical Education, 55(9), 790-792.

Mevarech, Z. R. (1980). The role of teaching-learning strategies and feedback-corrective procedures in developing higher cognitive achievement (Doctoral dissertation, University of Chicago, 1980). Dissertation Abstracts International, 41, 1031A.

Mevarech, Z. R. (1983). The role of a feedback-corrective procedure in developing psychomotor application skills. Journal of Vocational Education Research, 8(2), 22-32.

Mevarech, Z. R., & Amiran, M. R. (1982). The role of criterion-referenced testing in improving mathematical achievement. Educational Evaluation and Policy Analysis, 4(3), 355-362.

Moody, F. E. (1970). The differential effects of teacher comments on college females' achievement as measured by test performance (Doctoral dissertation, University of Rochester, 1969). Dissertation Abstracts International, 30, 3328A.

Nishikawa, S. S. (1985). Feedback: Implications for further research and study. Paper presented at the annual convention of the Association for Educational Communications and Technology, Anaheim, CA. (ERIC Document Reproduction Service No. ED 256 328)

Page, E. B. (1958). Teacher comments and student performance: A seventy-four classroom experiment in school motivation. Journal of Educational Psychology, 49, 173-181.

Peeck, J., and Tillema, H. H. (1979). Delay of feedback and retention of correct and incorrect responses. Journal of Experimental Education, 47, 171-178.

Plowman, L., & Stroud, J. B. (1942). Effect of informing pupils of the correctness of their responses to objective test questions. Journal of Educational Research, 36, 16-20.

Rhoads, P. A. (1968). Relationship between teacher comments and the performance of slow learners (Doctoral dissertation, University of Maryland, 1967). Dissertation Abstracts International, 28, 2498A.

Sassenrath, J. M. (1975). Theory and results on feedback and retention. Journal of Educational Psychology, 67, 894-899.

Sassenrath, J. M., & Garverick, C. M. (1965). Effects of differential feedback from examinations on retention and transfer. Journal of Educational Psychology, 56, 259-263.

Shrago, M. I. (1970). The effect of approving teacher comments on pupil achievement and attitude (Doctoral dissertation, University of Kansas, 1969). Dissertation Abstracts International, 30, 5302A.

Simons, R. H. (1971). The effect of written differential incentives on academic performance at the upper elementary level (Doctoral dissertation, University of Miami, 1971). Dissertation Abstracts International, 32, 6227A.

Solomon, D., & Rosenberg, L. (1964). Teacher-student feedback and classroom social structure. Journal of Social Psychology, 62, 197-210.

Starkey, K. T. (1971). The effect of teacher comments on attitude toward and achievement in secondary mathematics classes: An experimental study (Doctoral dissertation, Pennsylvania State University, 1970). Dissertation Abstracts International, 32, 259A-260A.

Stewart, L. G. (1975). The differential effects of letter grades and written teacher comments on student objective test performance (Doctoral dissertation, Teachers College, Columbia University, 1974). Dissertation Abstracts International, 35, 6520A-6521A.

Stewart, L. G., & White, M. A. (1976). Teacher comments, letter grades, and student performance: What do we really know? Journal of Educational Psychology, 68, 488-500.

Sturges, P. T. (1972a). Effects of instruction and form of informative feedback on retention of meaningful material. Journal of Educational Psychology, 63, 99-102.

Sturges, P. T. (1972b). Information delay and retention: Effect of information in feedback and tests. Journal of Educational Psychology, 63, 32-43.

Sweet, R. C. (1966). Educational attainment and attitudes toward school as a function of feedback in the form of teachers' written comments. Madison: University of Wisconsin. (ERIC Document Reproduction Service No. ED 015 163)

Wentling, T. L. (1973). Mastery versus nonmastery instruction with varying test item feedback treatments. Journal of Educational Psychology, 65, 50-58.

APPENDIX : Student Survey

STUDENT SURVEY

Tell if you (1) strongly agree,
(2) agree,
(3) have no opinion,
(4) disagree,
or (5) strongly disagree with each of these statements about chapter tests.

_____ 1. Tests are an important part of learning.

_____ 2. Studying for tests usually helps me get better grades on tests.

_____ 3. Tests make me nervous.

_____ 4. Test scores are a true measure of what I've learned.

_____ 5. I don't know how to study for tests.

_____ 6. Tests are a waste of time.

_____ 7. Tests are valuable to my teacher.

_____ 8. I can learn from the tests I take.

_____ 9. I look forward to seeing the results of my test.

_____ 10. Test are not valuable to me.

_____ 11. I want to know how to correct the mistakes I may have made on tests.

_____ 12. I don't care if I ever get my test papers back.

_____ 13. I don't pay much attention to comments or corrections on the tests that are returned to me.

_____ 14. My teacher helps me learn from my mistakes on tests.

_____ 15. My teacher gives me the special help I need to enable me to improve my work.

_____ 16. I show my test papers to my parents.

Please comment below on tests, how tests are marked, or the information you receive about your tests:

_____

_____

_____